Coastal flooding in Denmark – future outlook

Sørensen, C.; Knudsen, P.; Andersen, O. B.

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changes are closely linked to large scale and low-frequency climate variations. Our results demonstrate the importance of assessing the risk of compound flooding within the design process of coastal and urban infrastructure in a non-stationary framework and to explore the potential effects of climate change on these high impact events.

TP6-O-15: Coastal flooding in Denmark – future outlook

Sørensen, C.[1,2]*, P. Knudsen[1] and O. B. Andersen[1]

*E-Mail: cas@kyst.dk

[1]*DTU Space, Lyngby, Denmark*

[2]*Danish Coastal Authority, Lemvig, Denmark*

Water loading from all directions due to river discharge, precipitation, groundwater and the sea state (i.e. mean and extreme water levels) need to be carefully considered when dealing with flooding hazards at the coast. Flooding hazard and risk mapping are major topics in low-lying coastal areas before even considering the adverse effects of climate change and sea level rise (SLR). From an assessment of Danish sea extremes from historical evidence, tide gauge series, and space measurements, we discuss the current and future hazards, exposure, and vulnerability to flooding along the diverse Danish coastline in the transition between the Baltic Sea and the North Sea. The evaluation of the extreme statistics and their applicability in flooding hazard and risk management, and a presentation of the hazard and risk mapping performed through the implementation of the EU Floods Directive using the German XtremRisk approach, form the basis for projecting potential impacts of flooding due to climate change (SLR and increased storminess). Central to this impact assessment are also the evaluation of natural meteorological variability, robustness of the statistics, physical changes, local subsidence, land-use, protection measures a.o. that must be taken into account in order to evaluate current and future flooding hazards and management options. We provide examples from Danish case-studies underlining the necessity of including these factors and we outline an interdisciplinary approach to bring this knowledge together to enable a practice-oriented methodology that combines their effects and future sea extremes in hazard and risk mapping and climate change adaptation schemes in Denmark.

TP6-O-16: Flash flood emergency planning and warning for the City of Luebeck based on hydrodynamic modelling

Schlauss, S.[1]*, M. Grottker[1], T. Einfalt[2], B. Schaeffers[3], H. Deng[1] and A. Jackisch[2]

*E-Mail: sebastian.schlauss@fh-luebeck.de

[1]*Luebeck University of Applied Sciences, 23562 Luebeck, Germany*

[2]*hydro & meteo GmbH & Co. KG, 23552 Luebeck, Germany*

[3]*Hanseatic City of Luebeck, 23560 Luebeck, Germany*

Heavy rainfall events can cause severe damage through urban flash floods on a local scale. The project RainAhead has been conceived to reduce potential risks caused by urban flash floods for the City of Luebeck. The project's main objective is to develop a planning and warning tool to improve the flood damage mitigation and the emergency service's effectiveness.

The project includes an assessment of potential climate change impacts with respect to heavy rainfall. A vulnerability map will be created containing information on areas and objects susceptible to urban flooding. A detailed 1D/2D coupled hydrodynamic simulation will show flow paths of surface water (2D), bottlenecks in the urban drainage system (1D) and potentially flooded areas. The information will be used by the planning tool, which shows different planning scenarios and their consequences. The warning tool will combine the vulnerability map, modelling results and the current weather situation, and will issue real-time warnings for objects that would be subject to flooding. RainAhead is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB).

TP6-O-17: Hail hazard in Europe: Analysis based on the overshooting cloud top (OT) proxy and reanalysis data

Punge, H. J.[1,3]*, K. M. Bedka[2] and M. Kunz[1]

*E-Mail: punge@kit.edu

[1]*Institute of Meteorology and Climate Research, KIT, Karlsruhe, Germany*

[2]*NASA Langley Research Center, Hampton, VA, USA*

[3]*Willis Research Network, London, UK*

In the absence of large scale observing networks for hail, continental-scale climatological studies have to rely on proxies derived from remote-sensing observations such as radar and satellite products.

Overshooting of air masses atop thunderstorm anvil clouds (overshooting top, OT) was proven to be a reliable indicator of severe thunderstorms, including hail and can be detected from routine weather satellite observations due to very low cloud top temperatures. In combination with hail reports from the ESWD, the OT observations form 2004-2011 are used to build a climatology of hail events in Europe and to derive a stochastic risk model that is applied in the insurance industry.

A hazard map, featuring high frequency regions neighbouring the Alps and the Pyrenees, will be presented. Further maxima in the near Massif Central and in central Eastern Europe confirm the impact of topography on hailstorm frequency.

Meteorological conditions in the proximity of OT detections and ground hail reports respectively, are evaluated in the ERA-INTERIM reanalysis and the key parameters identified. Spatial variations within Europe and differences between the OTs and ESWD hail reports are discussed. These results can hint on biases of the OT proxy, but also the future evolution of hail hazard in the context of a changing climate.